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Medical audit

Peri-operative fluid and electrolyte management: a survey of consultant surgeons in the UK

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***Background*: Current peri-operative fluid and electrolyte management in the UK may be suboptimal. We assessed the attitudes of consultant surgeons to fluid and electrolyte prescribing and gathered suggestions for improvement in education on the subject.**

***Methods*: A postal questionnaire survey was sent to 1091 Fellows of the Association of Surgeons of Great Britain and Ireland. Of the 730 (67%) replies, 20 were invalid or incomplete, and 710 (65%) questionnaires were analysed. Outcome measures included provision of guidelines and teaching to junior staff on fluid and electrolyte prescribing, appropriateness of fluid management and suggestions to improve standards.**

***Results*: Junior staff were given written guidelines in 22% of instances. Only 16% of respondents felt that their preregistration house officers (PRHOs) were adequately trained in the subject before joining the firm; 15% also stated that PRHOs did not receive much training on their firm. 65% felt that fluid balance charts were accurately maintained, nursing shortages being the commonest reason for inaccuracies. Only 30% felt that postoperative patients were receiving appropriate amounts of water, sodium and potassium. Respondents who had been consultants for > 5 years were more likely to prefer erring on the side of under-replacement of fluid than those who were consultants for □5 years (63% *versus* 47%, $P < 0.0005$). Suggestions for improvement in education included problem-oriented ward rounds, written guidelines, and discussion of patient scenarios.**

***Conclusions*: Consultant surgeons feel that present practice in peri-operative fluid management is unsatisfactory. Higher standards within clinical governance and risk management may be achieved by focused practical training combined with formal written guidelines.**

Key words: Peri-operative – Fluid management – Electrolyte management – UK consultant surgeons – Survey

The 1999 UK National Confidential Enquiry into Perioperative Deaths report[1] has suggested that fluid imbalance contributes to serious postoperative morbidity and mortality and has recommended that 'training in fluid management, for medical and nursing staff, is required to increase awareness and spread good practice'. An earlier retrospective study[2] showed that peri-operative fluid prescriptions are extremely variable, with some patients receiving as much as 5 l of fluid and 740 mmol of sodium per day. We recently conducted a

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Table 1 Responses to the questions: who is the primary prescriber of fluid and electrolytes and who should prescribe in an ideal world?

	Who should prescribe in an ideal world							
Actual primary prescriber	PRHO	SHO	Specialist registrar	Staff grade	Consultant	Mixed juniors	Juniors + consultant	Total
PRHO	189	65	96	1	24	6	2	383
SHO	5	73	45	1	8	3	0	135
Specialist registrar	4	8	85	0	9	0	1	107
Staff grade	0	0	1	2	3	1	0	7
Consultant	1	0	5	0	8	0	1	15
Mixed juniors	3	6	6	0	1	24	5	45
Juniors + consultant	2	0	3	0	2	0	10	17
Total	204	152	241	4	55	34	19	709*

* One respondent did not answer this question.
Rectangles indicate a match between replies concerning actual primary prescriber and who should prescribe (*e.g.* while 383 consultants stated that the PRHO was the primary prescriber, only 204 thought that this should be the case. In 189 instances, there was a match between PRHOs actually prescribing and consultants who thought this was appropriate.)

telephone questionnaire survey on 200 junior surgical doctors in the UK[3] which showed that preregistration house officers (PRHOs), who are not ideally equipped either by experience or knowledge, are given the major responsibility for fluid and electrolyte prescribing, without much guidance or supervision. Peri-operative fluid and electrolyte therapy in the UK is, therefore, an area of concern in terms of practice and training.

This survey was designed to assess the attitudes of consultant surgeons to fluid and electrolyte prescribing and to garner suggestions for improvement in education and training in the subject in order to promote better practice.

Materials and Methods

A postal questionnaire was designed and piloted. The questionnaire was then sent to 1091 British Fellows of the Association of Surgeons of Great Britain and Ireland in May and June 2000, after obtaining approval from the Secretary of the Association. Reminders were sent to non-responders after 2 months. The questionnaire was printed on an optically readable form (Formic Scanning Systems, UK – http://www.formic.co.uk) and responses were exported into a Microsoft Access 2000 database (Microsoft Corporation). The χ^2 and χ^2 for linear trend tests were used to determine statistical significance using Epi Info 2000 software (http://www.cdc.gov/epiinfo). Differences were considered significant at $P < 0.05$.

Results

Of the 1091 questionnaires sent, two were returned because of an incorrect address. Initially, 587 replies (54%) were received and a further 143 questionnaires were returned after sending 502 reminders, an overall response rate of 67% (730/1089). Of the responders, 14 did not complete the questionnaire because they had retired, one declined to answer and five felt the questionnaire was inappropriate because they had no junior staff working with them. Therefore, 710 (65%) questionnaires were analysed.

Respondents had been consultants for a median (interquartile range) of 12 years (6–18 years), with 147 (21%) having been in post for ≤ 5 years. Of the respondents, 424 (60%) were based in district general hospitals, 180 (25%) worked in main teaching hospitals, 99 (14%) in associated teaching hospitals and 7 (1%) worked only in the private sector.

Table 2: Provision of guidelines or teaching on fluid and electrolyte prescribing

	District general hospital	Associated teaching hospital	Main teaching hospital	Total
Formal written guidelines $P = 0.008$, χ^2 for linear trend test				
Yes	79 (19)	26 (26)	50 (28)	155 (22)
No	345 (81)	73 (74)	129 (72)	547 (78)
Don't know			1 (0.6)	1 (0.1)
Verbal guidelines $P = 0.9$ (NS), χ^2 for linear trend test				
Yes	368 (87)	87 (88)	156 (87)	611 (87)
No	56 (13)	12 (12)	24 (13)	92 (13)
Induction course $P = 0.5$ (NS), χ^2 for linear trend test				
Yes	257 (61)	68 (69)	112 (62)	437 (62)
No	74 (17)	13 (13)	19 (11)	106 (15)
Don't know	93 (22)	18 (18)	49 (27)	160 (23)

'Don't knows' and 'Nos' were grouped together for statistical calculations.
All figures are *n* (%).

Table 3: Training of junior staff in fluid and electrolyte prescribing

	PRHOs	SHOs	Specialist registrars
Junior staff with adequate prior training	113 (16)	384 (54)	602 (85)
Received further training	96 (85)	288 (75)	330 (55)
Did not receive much further training	17 (15)	96 (25)	272 (45)
Junior staff without adequate prior training	584 (82)	299 (42)	76 (11)
Received further training	496 (85)	232 (78)	49 (65)
Did not receive much further training	88 (15)	67 (22)	27 (35)

As stated in the responses, 13 consultants did not have PRHOs, 27 did not have SHOs and 32 did not have SpRs.
All figures are *n* (%).

While 383 (54%) consultants stated that the PRHO was the primary prescriber of fluid and electrolytes, only 204 (29%) thought that this should be the situation in an ideal world (Table 1).

Responses to questions concerning provision of guidelines or teaching to junior staff on fluid and electrolyte prescribing are summarised in Table 2. Consultants in main teaching and associated teaching hospitals were more likely to provide their junior staff with written guidelines than those in district general hospitals. Of the total analysed, 38 consultants did not provide their junior staff with written or verbal guidelines and answered 'no' or 'don't know' when asked whether fluid and electrolyte balance was included in the induction programme for junior staff.

While the majority of consultants felt that their PRHOs and SHOs were not adequately trained in fluid and electrolyte prescribing before commencing work on the firm, a significant number admitted that juniors were not provided with much training whilst on the firm (Table 3). Of the consultants, 420 (59%) stated that they always checked fluid balance charts on their business ward rounds, 235 (33%) checked them frequently, 53 (7%) sometimes and 2 (0.3%) never did so. Fluid balance charts were perceived to be inaccurate by 248 (35%) of consultants. Charts were more likely to be inaccurate in district general hospitals (37%) and associated teaching hospitals (42%) than in main teaching hospitals (28%; $P = 0.04$, χ^2 for linear trend test). The most common reasons cited for inaccuracies were nursing shortages (132, 53%), inadequately trained or inefficient nurses (73, 29%), failure to recognise the importance of fluid balance charts (26, 11%) and other reasons which included poor form design and partial shifts (10, 4%); 7 (3%) respondents gave no reason.

Most respondents felt that their patients were not receiving appropriate amounts of water, sodium and potassium (Table 4). Of the respondents, 385 (54%) either agreed (302) or agreed strongly (83) that salt and water overload frequently causes significant complications in postoperative patients while 325 (46%) either disagreed (304) or disagreed strongly (21). While 423 (60%) respondents preferred their juniors to err on the side of under-replacement of fluid in their postoperative patients, and 227 (32%) on the side of over-replacement, 60 (8%) felt that neither was desirable. Respondents who had been consultants for > 5 years were more likely to prefer erring on the side of under-replacement of fluid than those who were consultants for ≤ 5 years (63% [354/563] *versus* 47% [69/147]; $P < 0.0005$, χ^2 test).

Table 4: Water, sodium and potassium prescribing

	Too much	Too little	About right
Water	267 (38)	82 (12)	361 (51)
Sodium	188 (26)	105 (15)	417 (59)
Potassium	10 (1)	321 (45)	379 (53)

Right amount of water, sodium and potassium = 215 (30).
All figures are *n* (%).

While 494 (70%) respondents felt that early postoperative fluid balance is best managed by surgeons, 143 (20%) thought this was best left to anaesthetists, 15 (2%) to others (such as specialist nurses) and 58 (8%) felt it should be under the joint care of surgeons and anaesthetists.

Finally, the most favoured suggestions for improvement in educational and training programmes on peri-operative fluid and electrolyte management are listed in Table 5.

Discussion

The high response rate to this survey indicates that surgical consultants in the UK consider fluid and electrolyte management important. The results of the enquiry highlight present problems and suggest some solutions.

The results of a recent survey of 200 junior doctors suggested that the PRHO was primarily responsible for fluid and electrolyte prescribing in 89% of instances,[3] although the present enquiry suggests that this was so in only 54% of surgical firms. This may reflect a difference in

Table 5 Suggestions to improve educational programmes on fluid and electrolyte management

	Ranked 1st (*n*)	Ranked 2nd (*n*)	Ranked 3rd (*n*)	Total ranks (*n*)
Problem orientated ward rounds for senior students and new PRHOs	266	189	92	547
Formal written guidelines at the start of each PRHO and SHO job	148	185	146	479
Discussion of patient scenarios and management plans in the final year of medical school	123	156	146	425
Special study module in final year of medical school	121	63	91	275
Inclusion of vivas/OSCEs on fluid and electrolyte management in the MRCS examination	41	97	195	333

OSCEs, objective structured clinical examinations. MRCS, Member of The Royal College of Surgeons.

perception rather than reality. However, only 29% of consultants felt that PRHOs should be the primary prescribers, with 34% and 8%, respectively, thinking that this should be the responsibility of specialist registrars or consultants.

Only 38 (5.4%) consultants reported that their junior staff were not given any form of guidelines on fluid prescribing. In our junior doctor survey, however, more than 60% of PRHOs and 80% of SHOs said that they had not received any guidelines on the subject.[3] This striking discrepancy may be because of differences in interpretation of the term 'guidelines', or due to the fact that junior doctors either do not read written guidelines or do not remember verbal ones.

Of the consultants, 584 felt that their PRHOs had received inadequate previous training in fluid and electrolyte prescribing and 88 of these admitted that this group of PRHOs did not receive much training on the subject whilst working on the firm. Inaccuracies in fluid balance charting appear to be an institutional nursing problem, which should be addressed by improved nurse training and staffing, and increased awareness of the importance of accurate fluid balance charting in surgical patients.

Only 30% of consultants felt that their patients were receiving the required dose of water, sodium and potassium. These results closely match those of our earlier survey[3] in which we found that a quarter of junior doctors were prescribing excessive amounts of sodium and only half were prescribing the required amount of potassium.

Although the majority (54%) felt that even moderate salt and water overload can cause postoperative complications, a substantial minority disagreed. It is interesting to note that consultants appointed more than 5 years ago were more likely to be cautious in prescribing salt and water infusions than those appointed more recently. This may be because the more senior consultants were influenced by authors like Moore who in 1967[4] concluded: 'The objective of (peri-operative) care is restoration to normal physiology and normal function of organs, with a normal blood volume, functional body water and electrolytes. This can never be achieved by inundation.' On the other hand, the Advanced Trauma Life Support and the Care of the Critically Ill Surgical Patient Courses may have influenced the responses of more recently appointed consultants.

While the teachings of these courses are appropriate for hypovolaemic patients or patients with significant measured losses, they are not necessarily true for the maintenance of the uncomplicated elective surgical patient.[5]

There was some disagreement among respondents as to who should be responsible for immediate postoperative fluid prescription. Anaesthetists and surgeons both have a role, but it needs to be better co-ordinated using evidence-based protocols, since wide differences in practice exist based on tradition rather than scientific information.

Better training and education of doctors and nurses is the key to improvement in the management of fluid and electrolyte balance. Theoretical lectures on their own are inadequate for training in this essentially practical subject. Problem orientated ward rounds for medical students and PRHOs, with discussion of patient scenarios and management problems, as well as practical apprenticeship and guidance during the PRHO period are also required. Written guidelines were a popular suggestion, but there needs to be some method of ensuring that they are read and followed. Computerised self-learning packages may also be useful. OSCEs/vivas on fluid and electrolyte management are already included in the MRCS examination, but, as the bulk of prescribing is done by PRHOs, this measure is unlikely to have a major influence on patient care. Consultants and specialist registrars should play a more active role in the management of fluid and electrolyte balance in patients undergoing major surgery and in the training of junior staff in this subject.

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